IN THE UNITED STATES DISTRICT COURT
FOR THE NORTHERN DISTRICT OF ILLINOIS
WESTERN DIVISION

THE UNITED STATES OF AMERICA and	)	
	)	
THE STATE OF ILLINOIS	)	
	)	
Plaintiffs,	)	
	)	
v.	)	Civil Action No. 3:15cv50250
	)	
THE CITY OF ROCKFORD, ILLINOIS,	)	
	)	
	)	
Defendant.	)	
	)	

CONSENT DECREE
APPENDIX J

THE CITY OF ROCKFORD ILLINOIS, USA

MONITORING AND SAMPLING PROGRAM

STANDARD OPERATING PROCEDURES

June 2015

1.0 General

The purpose of this standard operating procedure (SOP) for the Monitoring Program is to comply with Part II, A.7 & 9 and Part V, A & B of the City of Rockford's NPDES Storm Water Permit (ILS000001). This document addresses the procedures for the collection of water quality samples in varying conditions and locations for Representative Monitoring, Industrial High Risk Runoff and Illicit Discharge Detection & Elimination Monitoring. The City shall follow the NPDES Permit terms should there be any conflict or deviation with any portion of this SOP.

Additional guidance can be found in: *Illicit Discharge Detection and Elimination, A Guidance Manual for Program Development and Technical Assessments* by the Center for Watershed Protection.

2.0 Legal Authority

Legal authority for the Monitoring Program is found in the City of Rockford's Code of Ordinances Chapter 109, Article 12.

3.0 Staffing

Positions of the City of Rockford's Stormwater Environmental Team (SWET) include: Engineering Operations Manager, Stormwater Program Manager(s), Stormwater Coordinator and designated Project Managers and Engineering Techs.

Monitoring & sampling will be performed by the Public Works Engineering Division utilizing the following staff positions: Operations Manager(s), Program Manager(s), Project Manager(s), and Coordinator(s). These positions shall be trained to perform these functions according to the Standard Operating Procedures for Stormwater and Environmental Education and shall be familiar with this document.

Safety while completing any of these tasks is a top priority. Staff should always be aware of their surroundings and any potential hazards in the area.

4.0 Laboratory

The City shall use the Rock River Water Reclamation District (RRWRD) Laboratory (unless otherwise determined by the City) to analyze the samples collected. The laboratory hours are from 8:00 am – 4:30 pm on weekdays and are closed on weekends. Grab samples of fecal coliform are not accepted on Fridays or after 3:30 pm, Monday thru Thursday.

Field staff completing the sample collection should notify the lab contact or lab (typically by email) to inform them a delivery is forthcoming prior to the start of the sample collection operation.

Location	Lab Contact
RRWRD Lab	Mary Johnson, Lab Supervisor
3333 Kishwaukee Street	mjohnson@rrwrd.dst.il.us
Rockford, Illinois 61109	(815) 387-7523
(815) 387-7522	
web_lab@rrwrd.dst.il.us	

The field staff that collected the sample shall be the same person to deliver the sample to the lab. If this cannot be accomplished then it shall be documented when and to whom the sample was transferred to for delivery on the Sample Sheets. When delivering the sample the field staff must supply a City of Rockford employee identification card to the security guard at the entrance gate of the RRWRD complex. Staff will receive a gate opener to get to the laboratory and will return the opener and receive the identification back upon exiting the complex.

5.0 Representative Monitoring

The City's representative monitoring program includes in-stream sampling of tributaries to the Rock River and representative outfalls. Appendix A lists the Analytical Parameters to be sampled.

5.1 Tributary Monitoring

Tributary sites are analyzed for a suite of nutrient, heavy metal, and conventional water quality parameters, as noted in Appendix A.

5.1.1 Locations

Samples are collected at the following five (5) urban tributary locations:
(Refer to the site maps being Appendixes D-H for detailed locations)

Site ID	Locations
T1	North Kent Creek @ Fairgrounds Park
T2	South Kent Creek @ Tay & Corbin St.'s
T3	Keith Creek @ Tenth Avenue Park
T4	Keith Creek @ Dahlquist Park
T5	Spring Creek @ Starkweather Avenue

5.1.2 Frequency

Four dry weather samples will be collected on the second Monday in the months of February, May, August and November. A dry weather period is that which occurs at least 72 hours from a previously measurable (greater than 0.1 inch rainfall) storm event. The day of Monday was selected to complete these sample collections is based on an understanding with the RRWRD Lab and their workload. If weather conditions preclude collection of samples as scheduled, the sample collection shall be re-scheduled with the RRWRD Lab when and as conditions allow. Some conditions that may delay the collection of samples include but are not limited to: extreme temperatures, frozen flows, flooded conditions, high velocity flows and/or drought conditions.

5.1.3 Supplies and Equipment

The basic supplies and equipment needed to collect water quality samples from flowing tributaries includes:

- Safety vest
- Hip waders
- YSI 556 DO Meter
- Cooler (for storing and transporting samples)
- Ice (for preserving samples – obtained at the City Yards)
- Permanent marker (for labeling sample bottles)
- Tributary Sample Sheets, Appendix N
- Five (5) one-gallon plastic jugs (from the laboratory)
- Five (5) sterile six-ounce bottles (from the laboratory)
- Labels for the jugs and the sterile bottles (from the laboratory)

5.2 Representative Outfalls

The City of Rockford's NPDES Storm Water Permit No. ILS000001 (City's permit) details most of the criteria & requirements cited in this section. The City's permit identifies five representative outfall locations for monitoring.

5.2.1 Locations

Samples are collected at the following five (5) representative outfall locations:
(Refer to the site maps being Appendixes I-M for detailed locations

Source: Rockford Storm Water NPDES Permit No. ILS000001		
Outfall	**Location**	**Watershed Description**
Station R1	Paradise Boulevard	225 ac residential & open space
Station R2	Market St. & N. Water St.	50 ac commercial, offices & residential
Station R3	Fairview Blvd & Crosby St.	510 ac residential
Station R4	8th Street & Wills Avenue	780 ac industrial, commercial & residential
Station R5	Forest View Rd & 28th Ave	80 ac light industrial

These sites have been prepared for the installation of automatic samplers and tip-bucket rain gauges.

5.2.2 Frequency

Samples shall be collected in the spring and fall for a total of two sets of the required samples at each location (R1-R5) each year. Samples shall be collected from the discharge resulting from a storm event that is greater than 0.1 inches in magnitude and that occurs at least 72 hours from the previously measurable (greater than 0.1 inch rainfall) storm event.

5.2.3 Rain Event Data Collection

Data must be maintained for the following of each rain event:

- Date of event
- Duration of event (in hours)
- Rainfall measurements or estimates (in inches)
- Duration between event and end of previous event (in hours)
- Estimate of the total volume of the discharge sampled (in gallons)

The source of weather observation data to be used by Staff is from the National Weather Service website (http://w1.weather.gov/data/obhistory/KRFD.html) which reports the past 72 hours of weather data (including hourly rainfall data) from the Chicago Rockford International Airport. Copy and paste this data into the Rain Event data log spreadsheet found in the City's Storm Water directory.

5.2.4 Sampling Techniques for Representative Outfalls

The City's permit allows for grab samples and/or composite samples to be collected from the outfall sites. The use of automatic samplers is also allowed given proper programming of the unit. Appendix B denotes which technique to use, grab or composite, based on the type of sample to be collected.

5.2.4.1 Grab Sampling for Representative Outfall

Grab samples may be taken by hand or with the use of automatic samplers. Sampling consists of 3 grab samples; the first grab sample shall be taken within 2 hours after the commencement of the storm event. The second and third grab samples shall be taken at intervals of not less than 2 hours thereafter. Should the discharge cease before the 2nd and 3rd samples can be taken, Staff shall identify the approximate time that the discharge ceased.

5.2.4.2 Composite Sampling for Representative Outfall

Composite samples may be taken using automatic samplers that are triggered using either tipping-bucket rain gages programmed to initiate sampling after 0.1 inch of rain, or flow meters programmed to initiate sampling after 0.1 inches of runoff. Using automatic samplers to collect a composite sample is the preferred method.

5.2.4.3 Fecal Coliform Grab Sample for Representative Outfall

Staff will complete a grab sample to be tested for fecal coliform independent of the use of a composite or grab sampling technique. If possible, this grab sample will take place during the same storm event, but if this cannot be performed, these samples will be taken from separate events.

These samples should be collected directly from the discharge stream into the sterilized 6 oz Nalgene sample bottle with the sodium thiosulfate preservative. Do no overfill this bottle to ensure the proper amount of preservative remains with the sample.

5.2.5 Supplies and Equipment

The basic supplies and equipment needed to collect water quality samples from flowing tributaries includes:

- Safety vest
- Manhole hook
- YSI 556 DO Meter
- Cooler (for storing and transporting samples)
- Ice (for preserving samples – obtained at the City Yards)
- Permanent marker (for labeling sample bottles)
- Storm Sewer Sample Sheets, Appendix N
- Five (5) one-gallon plastic jugs (from the laboratory)
- Five (5) 1 liter glass sample bottle (from the laboratory)
- Five (5) sterilized, 6 oz. Nalgene sample bottle with sodium thiosulfate (Na2S2O3) preservative (from laboratory)
- Labels for the jugs and the sterile bottles (from the laboratory)
- ISCO automatic sampler (if necessary – pre-event setup required)
- Two-gallon polyethylene bottle (for use with automatic samplers).

Sample Bottles, Preservatives, and Maximum Holding Times
Field Technicians will deliver samples to the Laboratory within three hours of collection. Laboratory Analysts will split the sample needed for the analyses required and preserve accordingly.

5.3 Collection of Grab Samples

The laboratory will provide sample containers in accordance with Appendix B. The labeled uncapped bottle is submerged in the flow by hand, and allowed to fill without entraining surface or bottom debris. The sample is taken from a visibly flowing location that is deep enough to accommodate the sample container under these conditions. If there is no flow the samples should not be collected. Stagnant pools will not be sampled.

The filled containers are immediately placed in a cooler with water ice. The minimum information required on the label is the site identifier code, date and time, and sample designation (bottle type) as shown below. Laboratory issued stickers and/or tags may be used.

T-1 07-21-13 @ 1200 Fecal Coliform

5.4 Collection of Composite Samples

Composite samples are collected using the automatic samplers. Based on previous data, in order to collect the appropriate quantity for the required samples, the sampled rain event must produce 0.4 inches to 0.5 inches of total rainfall.

The samplers must be in-place prior to the start of a rain event. Installation and setup of the sampler is important for proper function. The following is a list of tasks to complete during this process:

- Install sampler before rain event
- Make sure battery for the sampler holds enough charge
- Verify the sampler is programmed properly (weather time or rain gauge weighted)
- Verify the intake tube is free of kinks and the line is clear of debris
- When using the tip bucket trigger, verify the connection is free of debris and moisture
- When using the tip bucket trigger, verify the tip bucket and screen is free of debris. A ladder will be required to complete this.
- Verify the program have been started before replacing the cover on the sampler

When staff returns for the collection of the sample, document the readout of the samplers display before completing other tasks. This data will provide rainfall totals registered by the sampler.

Pull the samplers internal bottle out and carefully fill the sample bottles provided by the laboratory. The filled containers are immediately placed in a cooler with water ice. The minimum information required on the label is the site identifier code, date and time, and sample designation (bottle type) as shown below. Laboratory issued stickers and/or tags may be used.

R-1 07-21-13 @ 1200 FOG

5.5 YSI 556 Meter – Field measurements

Field measurements of water quality (pH, DO, temperature, conductivity) are made in the same location following water sample collection. The meter must be properly calibrated according to the manufacturer's instructions for accurate measurements to be taken. Record this information on the Tributary or Storm Sewer Sample Sheet.

6.0 Illicit Discharge Detection and Elimination Indicator Monitoring

Illicit Discharge Detection & Elimination (IDDE) indicator monitoring is used to confirm illicit discharges, and provide clues about their source or origin when discovered though tributary, outfall monitoring or IDDE SOP. In addition, this monitoring can measure improvements in water quality during dry weather flow.

6.1 Where to Collect Samples

Indicator sampling normally occurs at three principle locations in the storm drain system to detect illicit discharges – at the outfall, in the stream, and within the storm drain pipe network.

Monitoring of dry weather flows from outfalls is the most common location for indicator sampling.

In-stream monitoring involves sample collection during dry weather flow conditions. Stream monitoring is less precise than outfall monitoring at detecting individual discharges. It can detect the most severe or high volume discharges, and measure progress over time in terms of changes in stream water quality.

In-pipe sampling is often needed to track down and isolate individual discharges once a potential discharge problem is encountered at an outfall.

6.2 When to Collect Samples

Indicator samples should be collected during dry weather periods to avoid flowing outfalls caused by storm water or groundwater infiltration. A dry weather period is that which occurs at least 72 hours from a previously measurable (greater than 0.1 inch rainfall) storm event. An exception to this is for response to reported active illicit discharges to which an investigation should occur immediately.

Time of day that sampling is conducted is particularly important when the suspected source is residential sewage. Peak water usage occurs in the morning and evening, therefore sampling in the early morning is recommended in these situations.

6.3 Supplies and Equipment

The basic supplies and equipment needed to collect water quality samples for IDDE includes:

- Safety vest
- Manhole hook
- YSI 556 DO Meter
- Hach DR 900 Colorimeter
- Hach 2100 Turbidity Meter
- Cooler (for storing and transporting samples)
- Ice (for preserving samples – obtained at the City Yards)
- Permanent marker (for labeling sample bottles)
- Storm Sewer or Tributary Sample Sheets
- One-gallon plastic jug per sample set (from the laboratory)
- One liter glass sample bottle per sample set (from the laboratory)
- Six oz. Nalgene sterilized sample bottle per sample set with sodium thiosulfate (Na2S2O3) preservative (from laboratory)
- Labels for the jugs and the sterile bottles (from the laboratory)
- ISCO automatic sampler (if necessary – pre-event setup required)
- Two-gallon polyethylene bottle (for use with automatic samplers).

Sample Bottles, Preservatives, and Maximum Holding Times

Field Technicians will deliver samples to the Laboratory within three hours of collection. Laboratory Analysts will split the sample needed for the analyses required and preserve accordingly.

6.4 Water Quality Indicators Used to Identify Illicit Discharges

Different water quality parameters can be used to confirm the presence or origin of an illicit discharge at a flowing storm drain outfall. These parameters, which are discussed in more detail in Appendix C, include:

- Ammonia
- Boron
- Chlorine
- Color
- Conductivity
- Detergents
- *E. Coli*, enterococci, or total coliform
- Fluoride
- Hardness
- pH
- Potassium
- Surfactants
- Turbidity

Table 1 summarizes these parameters, compares their ability to detect different flow types, and reviews some of the challenges that may be encountered when analyzing them in the lab or in the field.

Table 1: Water Quality Parameters Used to Identify Illicit Discharges

Parameter	Flow Types It Can Detect				Analytical Challenges
	Sewage	Wash Water	Tap Water	Industrial/ Commercial Waste	
Ammonia	●	⦿	○	⦿	Can change into other forms of nitrogen as flow travels to the outfall
Boron	⦿	⦿	○	N/A	
Chlorine	○	○	○	⦿	High chlorine demand in natural systems limit usefulness to flow with very high chlorine concentrations
Color	⦿	⦿	○	⦿	
Conductivity	⦿	⦿	○	⦿	Not useful in natural systems with high salinities
Detergents	●	●	○	⦿	Reagent is a hazardous waste
E. coli Enterococci Total coliform	⦿	○	○	○	24-hour test procedure Need to modify standard analytical procedures to measure high bacteria concentrations
Fluoride*	○	○	●	⦿	Regent is a hazardous waste
Hardness	⦿	⦿	⦿	⦿	
pH	○	⦿	○	⦿	
Potassium	⦿	○	○	●	May need to use two separate analytical techniques, depending on the concentration
Surfactants	●	●	○	⦿	Reagent is a hazardous waste
Turbidity	⦿	⦿	○	⦿	

Key:
● Can almost always (i.e., > 80% of the time) distinguish this flow type from clean water (e.g., tap water, natural water). For tap water, can almost always distinguish tap water from natural water.
⦿ Can sometimes (i.e., > 50% of the time) distinguish this flow type from clean water, depending on regional characteristics, or can be helpful when used with another parameter.
○ Poor indicator parameter. Cannot reliability distinguish an illicit discharge from clean water (e.g., tap water, natural water).
N/A Data are not available to assess the usefulness of this parameter in distinguishing this flow type from clean water (e.g., tap water, natural water).
* Fluoride is a poor indicator when used on its own. However, when it is used with other parameters, such as detergents, ammonia and potassium, it can almost always distinguish between sewage and wash water.

6.5 Selecting Indicator Parameters

As shown in Table 1, no single water quality parameter meets all of these criteria. However, in most cases, only a small subset of these parameters (e.g., three to five) is required to adequately confirm the presence of an illicit discharge. The CITY will use the parameters associated with the Flow Chart Method, as well as pH and chlorine, to confirm the presence of illicit discharges at flowing storm drain outfalls. Additional information about the Flow Chart Method is provided below.

6.6 Flow Chart Method

The primary data interpretation technique to be used to identify illicit discharges is the Flow Chart Method. The Flow Chart Method has been selected because it is a relatively simple interpretation technique that uses four basic water quality parameters to confirm the presence of an illicit discharge. The water quality parameters used in the Flow Chart Method can be used to distinguish amongst the four major flow types typically found in residential watersheds, including sewage and wash water, which are the most common types of illicit discharges found in urban communities.

The Flow Chart Method uses benchmark concentrations to identify and characterize illicit discharges. The benchmark concentrations were developed by CWP and Pitt (2004), Lalor (1994) and Pitt et al. (1993) from illicit discharge detection and elimination work conducted in Alabama and Maryland.

The basic decision points involved in the Flow Chart Method are shown in Figure 1 and described below.

6.6.1 Distinguish Clean Flow from Contaminated Flow Using Detergents

The first step in the Flow Chart Method is to determine whether the discharge is "clean" or is derived from either sewage or wash water, based on the presence of detergents. Surfactants and/or boron are used as the primary indicator of detergents, and values of surfactants or boron that exceed 0.25 mg/L or 0.35 mg/L, respectively, signal that the discharge is contaminated by either sewage or wash water.

6.6.2 Distinguish Wash Water from Sewage Using the Ammonia-to-Potassium Ratio

If the discharge contains detergents, the next step is to determine whether the discharge is derived from sewage or wash water, using the ammonia-to-potassium ratio. An ammonia-to-potassium ratio of greater than one suggests sewage contamination, while a ratio of less than one indicates wash water contamination.

6.6.3 Distinguish Tap Water from Natural Water

If the sample is free of detergents, the next step is to determine whether the flow is derived from natural sources (e.g., groundwater, springs) or from tap water. The indicator used in this analysis is fluoride, and values of fluoride that exceed 0.60 mg/L signal that tap water is the source. Fluoride concentrations of between 0.25 and 0.60 mg/L indicate that the source may be excess or non-target irrigation water. The purpose of determining the source of a relatively "clean" discharge is that it can identify water main breaks and identify where potable water is being used in a manner (e.g., non-target irrigation, vehicle rinsing, and building rinsing) that contributes polluted runoff to the storm drain system.

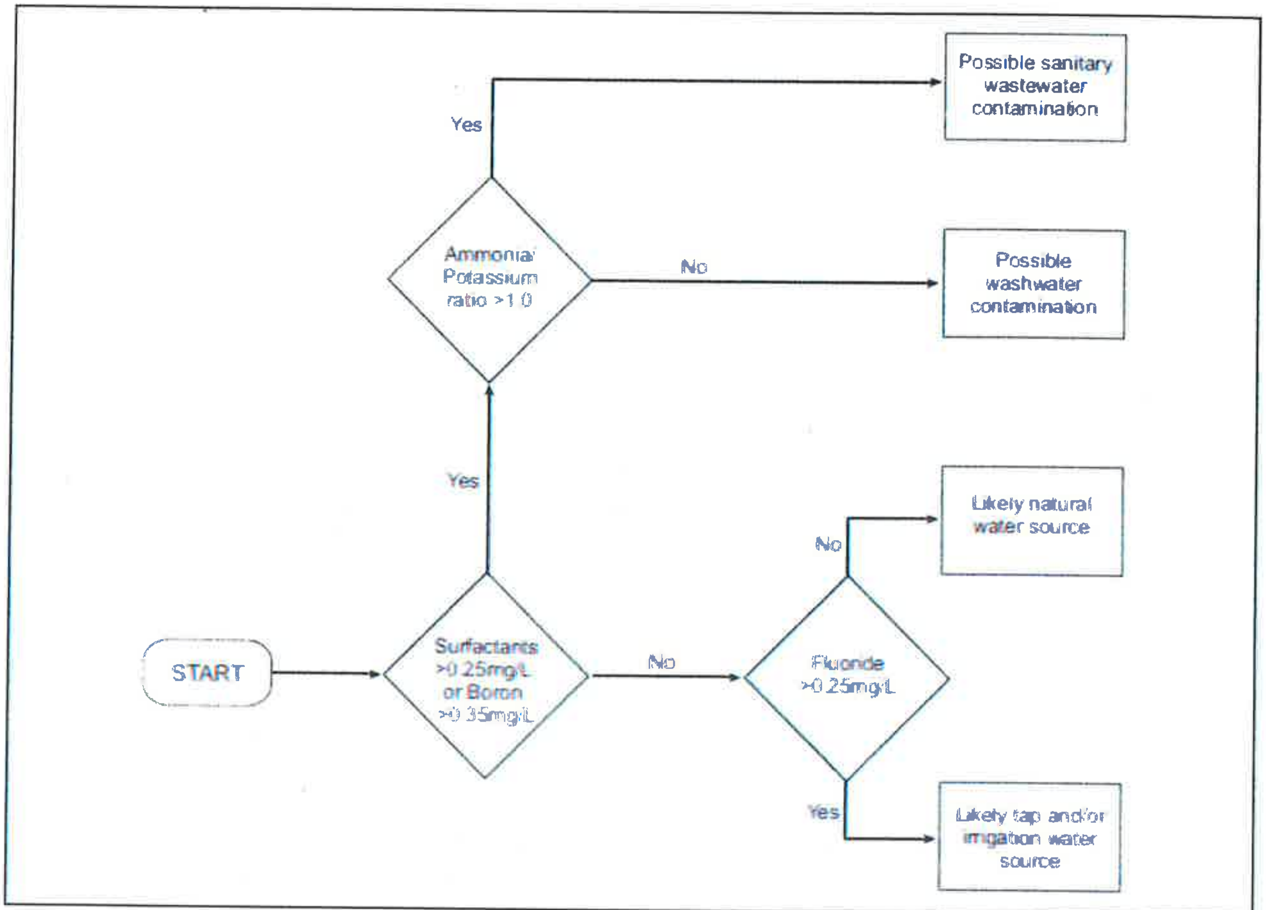


Figure 1: Flow Chart Method Used to Interpret Indicator Parameters

6.7 Interpreting Water Quality Data

This section provides information on three other techniques that the CITY may use to interpret water quality data with respect to illicit discharges. One or more of which the CITY may use to supplement the Flow Chart Method:

- Environmental Consultant – A consultant may be used when staff time is limited to analyze the test results or additional interpretation of the results is needed.
- Single Parameter Screening
- Industrial Flow Benchmarks

As with the Flow Chart Method, each of these techniques uses benchmark concentrations to identify and characterize illicit discharges. The benchmark concentrations were developed by CWP and Pitt (2004), Lalor (1994) and Pitt et al. (1993) from illicit discharge detection and elimination work conducted in Alabama and Maryland.

6.7.1 Single Parameter Screening

Research by Lalor (1994) suggests that a detergent is the best single parameter that can be used to detect the presence of the most common illicit discharges (i.e., sewage and wash water). However, ammonia is another parameter that has been used by some communities with widespread or severe sewage issues. While some communities have used a benchmark concentration as low as 0.30 mg/L, an ammonia concentration of greater than 1.0 mg/L is generally considered to be a positive indicator of sewage flow. Ammonia can be analyzed using a portable spectrophotometer, which provides fairly rapid results and allows investigators to begin tracking down and eliminating sources while they are still out in the field.

As a single indicator parameter, ammonia does have some limitations. First, ammonia, by itself, is not always capable of identifying sewage discharges, particularly if they have been diluted by "clean" flows. Second, while some wash waters and industrial wastes have relatively high ammonia concentrations, not all of them do. This increases the possibility of obtaining false negatives during outfall monitoring efforts. Third, other dry weather discharges, such as those caused by excess and non-target irrigation, can also have ammonia concentrations that exceed 1.0 mg/L. This may lead investigators to falsely assume that sewage is the source of a particular illicit discharge. Adding potassium as an indicator parameter and looking at the ammonia-to-potassium ratio is a simple adjustment to the single parameter approach that helps to more accurately and reliably characterize illicit discharges.

6.7.2 Industrial Flow Benchmarks

Commercial and industrial sites often produce illicit discharges that are not composed entirely of sewage or wash water (e.g., spills, discharges from floor drains). Consequently, if a particular sub-watershed or drainage area has a high density of industrial sites, additional water quality parameters may need to be used to identify and characterize illicit discharges.

The seven water quality parameters that are commonly used to identify the industrial-related illicit discharges and are not picked up by the Flow Chart Method include: ammonia, color, conductivity, hardness, pH, potassium and turbidity. Table 2 summarizes the benchmark concentrations that are commonly used to identify industrial-related illicit discharges.

Table 2: Parameters and Benchmark Concentrations Used to Identify Industrial-Related Illicit Discharges		
Parameter	**Benchmark Concentration**	**Notes**
Ammonia	≥ 50 mg/L	• Existing "Flow Chart" Parameter. • Concentrations higher than the benchmark typically can identify a few industrial-related illicit discharges
Color	≥ 500 units	• Supplemental parameter that identifies a few specific industrial illicit discharges. Should be refined with local data.
Conductivity	≥ 2,000 µS	• identifies a few specific industrial-related illicit discharges • May be useful in distinguishing between different industrial sources
Hardness	≤ 10 mg/L as $CaCO_3$ ≥ 2,000 mg/L as $CaCO_3$	• Identifies a few specific industrial illicit discharges • May be useful in distinguishing between industrial sources
pH	≤ 5	• Only captures a few industrial discharges • High pH values may also indicate an industrial discharge, but residential wash water may have high pH values as well
Potassium	≥ 20 mg/L	• Existing "Flow Chart" Parameter • Excellent indicator of a broad range of industrial discharges.
Turbidity	≥ 1,000 NTU	• Supplemental parameter identifies a few specific industrial discharges. Should be refined with local data.

As shown in Table 2, most industrial-related illicit discharges can consistently be identified by using potassium as an indicator parameter. Note that these discharges would be incorrectly classified as wash water if the Flow Chart Method was used on its own.

Table 3 illustrates how the industrial flow benchmarks can be used independently or to supplement the Flow Chart Method. The best industrial indicator parameters, which can almost always (i.e., > 80% of the time) distinguish industrial-related discharges from wash water and sewage, are identified with bold text. The industrial indicator parameters that can sometimes (i.e., > 50% of the time) distinguish industrial-related discharges from wash water and sewage are identified with italicized text.

By their very nature, industrial sites can produce a bewildering diversity of illicit discharges that are difficult to identify, let alone characterize. Consequently, the CITY may experience some initial difficulties in identifying industrial-related discharges. Over time, however, as its illicit discharge detection and elimination program matures, it will build a sampling database that it can use to identify and better characterize industrial-related illicit discharges.

Table 3: Usefulness of Various Parameters to Identify Industrial Discharges

Industrial Benchmark Concentrations	Detergents as Surfactants (mg/L)	Ammonia (mg/L)	Potassium (mg/L)	Initial "Flow Chart" Class	Color (Units)	Conductivity (:S/cm)1	Hardness (mg/L as $CaCO_3$)	pH	Turbidity (NTU)	Best Indicator Parameters to Identify This Flow Type	Additional Indicator Parameters to Identify This Flow Type
	--	≥50	≥20		≥500	≥2000	≤10 ≥2,000	≤5	≥1,000		
Concentrations in Industrial and Commercial Flow Types											
Automotive Manufacturer[1]	5	0.6	**66**	**Wash water**	15	220	30	6.7	118	Potassium	
Poultry Supplier[1]	5	4.2	**41**	**Wash water**	23	618	31	6.3	111	Potassium	
Roofing Product Manufacturer[1]	8	10.2	*27*	**Wash water**	*>100[2]*	242	32	7.1	229	None	Potassium Color
Uniform Manufacturer[1]	6	6.1	**64**	**Wash water**	*>100[2]*	798	35	10.4	*2,631*	Potassium	Color Turbidity
Radiator Flushing	15	(26.3)	**(2,801)**	**Wash water**	**(3,000)**	**(3,278)**	*(5.6)*	(7.0)	-	Potassium Conductivity Color	Hardness
Metal Plating Operation	7	**(65.7)**	**(1,009)**	**Wash water**	(104)	**(10,352)**	**(1,429)**	*(4.9)*	-	Ammonia Potassium Conductivity Hardness	pH
Commercial Car Wash	140	0.9; (0.2)	4; **(43)**	**Wash water**	>61; (222)	274; (485)	71; (157)	7.7; (6.7)	156		Potassium Turbidity
Commercial Laundry	(27)	(0.8)	3	**Wash water**	47	(563)	(36)	(9.1)	-		

Best indicator, shaded in pink, distinguish this source from residential wash water in 80% of samples in both Tuscaloosa and Birmingham, AL.

Supplemental indicator, shaded in yellow, distinguish this source from residential wash water in 50% of samples.

(Data in parentheses are mean values from Birmingham); Data not in parentheses are from Tuscaloosa

[1] Fewer than three samples for these industrial-related flows.

[2] The color analytical technique used had a maximum value of 100, which was exceeded in all samples. Color may be a good indicator of these industrial discharges and the benchmark concentration may need adjustment downward for the City of Rockford.

Source: Illicit Discharge Detection and Elimination, A Guidance Manual – Center for Watershed Protection October 2004.
(Please refer to this document for further guidance.)

Appendix A

Analytical Parameters

List of Water Quality Analyses	
Storm Water Analysis	**Tributary Site Analyses**
	Dissolved oxygen
5-day biochemical oxygen demand (BOD)	5-day biochemical oxygen demand (BOD)
Chemical oxygen demand (COD)	Chemical oxygen demand (COD)
Total Kjeldahl Nitrogen Ammonia Nitrogen Nitrate+nitrite Nitrogen	 Ammonia Nitrogen Nitrate+nitrite Nitrogen
Total Phosphorus	Total Phosphorus
Fats, Oils and grease	
Cadmium (total) Copper (total) Lead (total) Zinc (total)	Cadmium (total) Chromium (total) Copper (total) Lead (total) Nickel (total) Zinc (total)
pH	pH
Hardness	Hardness
Fecal coliform bacteria E. coli (occasionally, as laboratory capacity allows)	Fecal coliform bacteria E. coli (occasionally, as laboratory capacity allows)
Total suspended solids Total dissolved solids	Total suspended solids Total dissolved solids

Appendix B

Sample Bottles, Preservatives, and Maximum Holding Times

City Staff will deliver samples to the Laboratory within three hours of collection. Laboratory Analysts will split the sample needed for the analyses required and preserve accordingly.

Parameter	**Type**	**Container & Preservation**
Fecal Coliform (and E. coli)	Grab	Sterilized, 6 oz. Nalgene sample bottle **with sodium thiosulfate ($Na_2S_2O_3$) preservative**, chill with ice.
Fats, Oils & Grease	Grab	1 liter glass sample bottle, chill with ice.
All other parameters	Composite or Grab	1 gallon plastic sample bottle, chill with ice.

Bottles used in the automatic samplers are two-gallon polyethylene.

Laboratory analysts will preserve samples, as necessary immediately upon delivery to the laboratory. In cases when analysts begin the analysis immediately upon sample delivery, they may omit sample preservation. With the exception of metals, all samples are stored in a 4°C refrigerator.

Parameter	**Preservative**	**Hold Time**
DO (field)	NA	NA
Temperature	NA	NA
pH	NA	NA
Conductivity	NA	NA
Metals	HNO_3 to pH < 2	6 months
Nitrogen, Ammonia	H_2SO_4 to pH < 2	28 days
Nitrogen, Kjeldahl	H_2SO_4 to pH < 2	28 days
Nitrogen, Nitrate	---	48 hours
Phosphorus	H_2SO_4 to pH < 2	28 days
Biochemical Oxygen Demand	---	48 hours
Chemical Oxygen Demand	H_2SO_4 to pH < 2	28 days
Hardness	HNO_3 to pH < 2	6 months
Total Suspended Solids / Dissolved Solids	---	7 days
Oil and Grease	H_2SO_4 to pH < 2	28 days
Fecal Coliform (or E. coli)	sodium thiosulfate ($Na_2S_2O_3$)	6 hours

Appendix C

Water Quality Parameter Overview

This appendix provides an overview of the thirteen different water quality parameters that can be used to confirm the presence or origin of an illicit discharge.

Ammonia

Ammonia is a good indicator of sewage, since its concentration is much higher there than is ground or tap water. High ammonia concentrations may also be found in liquid waste streams generated on industrial sites. Ammonia is relatively simple and safe to analyze. Some challenges associated with analyzing ammonia include the tendency for it to volatilize and the fact that it can come from non-human sources, such as pets or wildlife.

Boron

Boron is an element present in the compound borax, which is often found in detergents and soaps. Consequently, boron should be a good indicator for both wash water and sewage. Preliminary research conducted in Alabama supports this contention, particularly when it is combined with other detergent indicators, such as surfactants. Boron may not be a useful indicator everywhere in the country since it is occasionally found at elevated levels in groundwater and is a common ingredient in a number of water softener products. Over time, the CITY should collect data on the boron concentrations found in local tap water and groundwater sources to confirm whether or not it is a useful local indicator of illicit discharges.

Chlorine

Chlorine is used throughout the country to disinfect tap water, except where private wells serve as the primary water supply. Chlorine concentrations in tap water tend to be significantly higher than those in most other flow types. Unfortunately, chlorine is extremely volatile, and even moderate concentrations of organic material can cause chlorine levels to drop below detection levels. Because chlorine is non-conservative, it is not a reliable indicator, although if a very high chlorine concentration is found, it typically indicates a water main break, swimming pool discharge, or a discharge from a chlorine-based industrial process.

Color

Color is a numeric computation of the color observed in a water quality sample, as measured in terms of cobalt-platinum units. Both industrial wastes and sewage tend to have elevated color values. Unfortunately, some "clean" flows can also have high color values. Field testing in Alabama found high color values associated with all contaminated flows, but also for many "clean" flows, which yielded many false positive results. Overall, color may be a good initial screening parameter, but needs to be supplemented by other indicator parameters.

Conductivity

Conductivity, or specific conductance, is a measure of how easily electricity can flow through water. Conductivity is often strongly correlated with the total amount of dissolved solids found in the water column. The utility of conductivity as an indicator depends on whether concentrations are elevated in natural or "clean" waters. In particular, conductivity is a poor indicator of illicit discharges in estuarine waters and in northern climates where salt is used to remove salt from roadways.

Field testing in Alabama suggests that conductivity has limited value in detecting sewage or wash water. It does, however, have some value in detecting industrial-related illicit discharges, some of which can exhibit extremely high conductivity values. Conductivity is extremely easy to measure using meters, so it has the potential to be a useful supplemental indicator in sub-watersheds dominated by commercial and industrial land uses.

Detergents

Most illicit discharges have elevated concentrations of detergents. Sewage and wash water discharges contain detergents that were used to wash clothes or dishes, whereas industrial-related discharges contain detergents used in commercial or industrial cleaning compounds. The nearly universal presence of detergents in illicit discharges, combined with their absence in natural waters or tap water, makes them an excellent indicator parameter. Research has revealed that three indicator parameters that measure detergents or its components: surfactants, fluorescence, and surface tension. Surfactants have been the most widely applied and transferable of these three indicator parameters.

E. coli, Enterococci and Total Coliform

Each of these bacteria is found in very high concentrations in sewage flows, particularly when compared with other flow types. They are very good indicators of sewage and septic discharges, except in sub-watersheds where pet or wildlife sources exist. Overall, bacteria is a good supplemental indicator and can be used to find "problem" outfalls that are discharging flows with bacteria concentrations that exceed public health standards. Relatively simple analytical methods are now available for bacteria samples, although they still suffer from two monitoring constraints. The first is the relatively long time (i.e., 18-24 hours) it takes to get results. The second is that the waste produced during analysis may be considered a biohazard and may require special disposal procedures.

Fluoride

Fluoride is added to drinking water supplies in most communities to improve dental health, and is normally found in tap water at a concentration of two parts per million. Consequently, fluoride is an excellent indicator of tap water discharges and water main breaks or leaks that end up in the storm drain system. Fluoride is obviously not a useful indicator in communities that do not fluoridate their drinking water supplies or in areas where private wells serve as the primary water supply. One key constraint is that the recommended analytical method for fluoride uses a reagent that is considered to be a hazardous waste. It must be properly disposed of.

Hardness

Hardness measures the number of positive ions dissolved in the water column. It primarily measures magnesium and calcium, but sometimes measures the presence of other metals. Field testing in Alabama suggests that hardness has limited value as an indicator parameter, except where values are extremely high or low, which may indicate the presence of an industrial-related discharge. It may be a useful supplemental indicator in communities where groundwater has hardness levels that are higher than those in tap water. In these situations, hardness can help distinguish between groundwater and tap water and other potable water-derived flows (i.e., sewage, wash water).

pH

Most discharges are neutral, having a pH value of around 7, although groundwater pH values can be somewhat variable. pH is a reasonably good indicator for industrial-related discharges, which can have very high or very low pH values ranging from 3 to 12. pH is very simple to measure in the field using low cost test strips or meters. Although pH, on its own, isn't a particularly conclusive indicator parameter, it can be used as an initial screening parameter, identifying outfalls that merit follow up investigation.

Potassium

Potassium is found at relatively high concentrations in sewage and in extremely high concentrations in many industrial-related discharges. Consequently, it is a very useful indicator parameter. Although simple meters can be used to detect potassium at relatively high concentrations (i.e., 5 mg/L or greater), more complex colorimetric methods are needed to detect potassium at concentrations lower than 5 mg/L.

Surfactants

Surfactants are the active ingredient in most commercial detergents and are typically measured as Methyl Blue Active Substances (MBAS). They are a synthetic replacement for soap. Since surfactants are not found in nature, but are always present in detergents, they are excellent indicators of sewage and wash water flows. The presence of surfactants in cleaners, emulsifiers and lubricants also makes them an excellent indicator of industrial-related discharges. Several analytical methods are available to measure the surfactant content of a water quality sample. Unfortunately, the reagents used in these analyses include toluene, chloroform or benzene, each of which is considered hazardous waste and each of which pose a potential human health risk. The recommended analytical method uses chloroform as a reagent, which is safer than the reagents used in the other analytical methods.

Turbidity

Turbidity is a quantitative measure of the cloudiness of a water column and is normally measured with a specialized instrument called a turbidimeter. While turbidity itself cannot always be used to distinguish between different flow types, it is potentially useful in determining whether or not a discharge is illicit and merits a follow up investigation.

Appendix D

Tributary Site Map

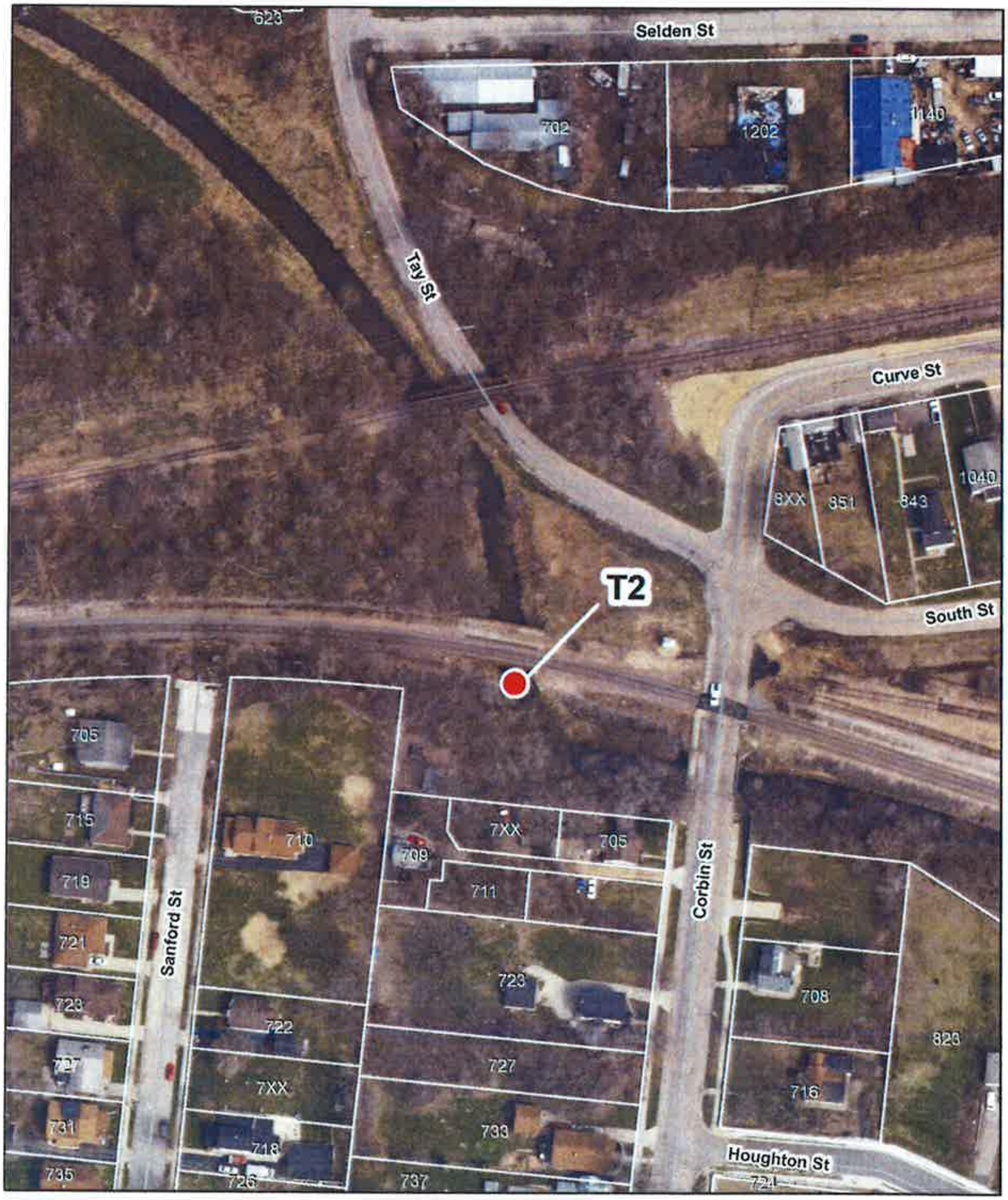
T1 - North Kent Creek @ Fairgrounds Park

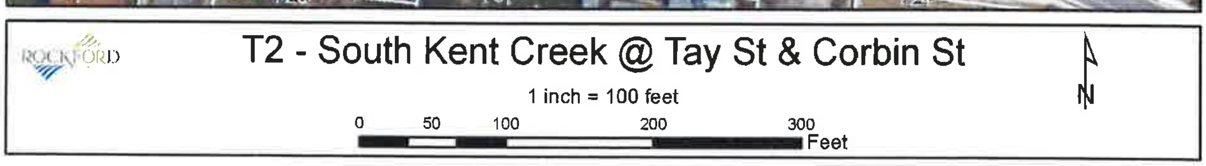
1 inch = 100 feet

0 50 100 200 300 Feet

Appendix E

Tributary Site Map





Appendix F

Tributary Site Map

T3 - Keith Creek @ Tenth Avenue Park

1 inch = 100 feet

0 50 100 200 300 Feet

N

Appendix G

Tributary Site Map

T4 - Keith Creek @ Dahlquist Park

1 inch = 100 feet

0 50 100 200 300 Feet

N

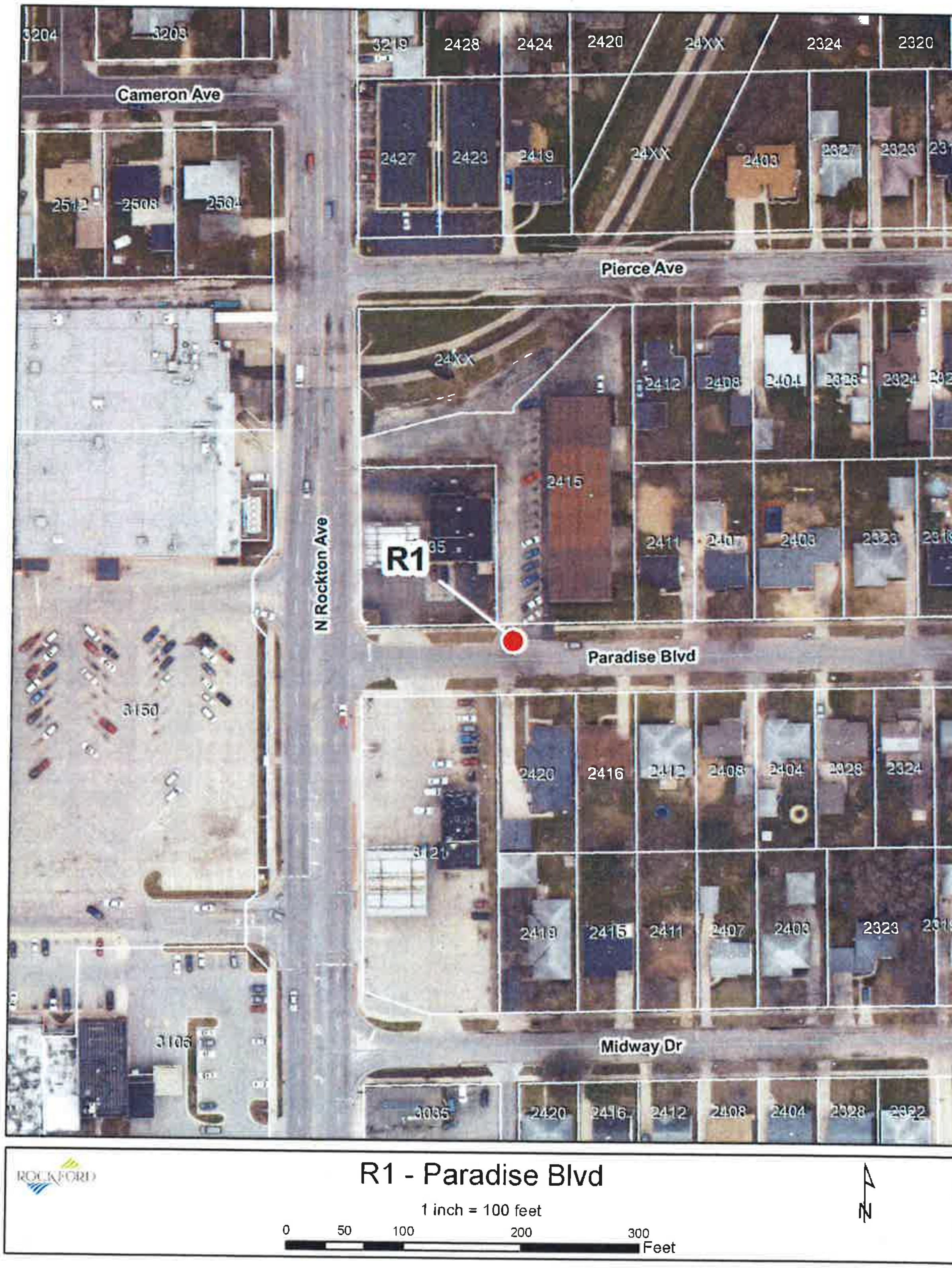
Appendix H

Tributary Site Map

T5 - Spring Creek @ Starkweather Ave

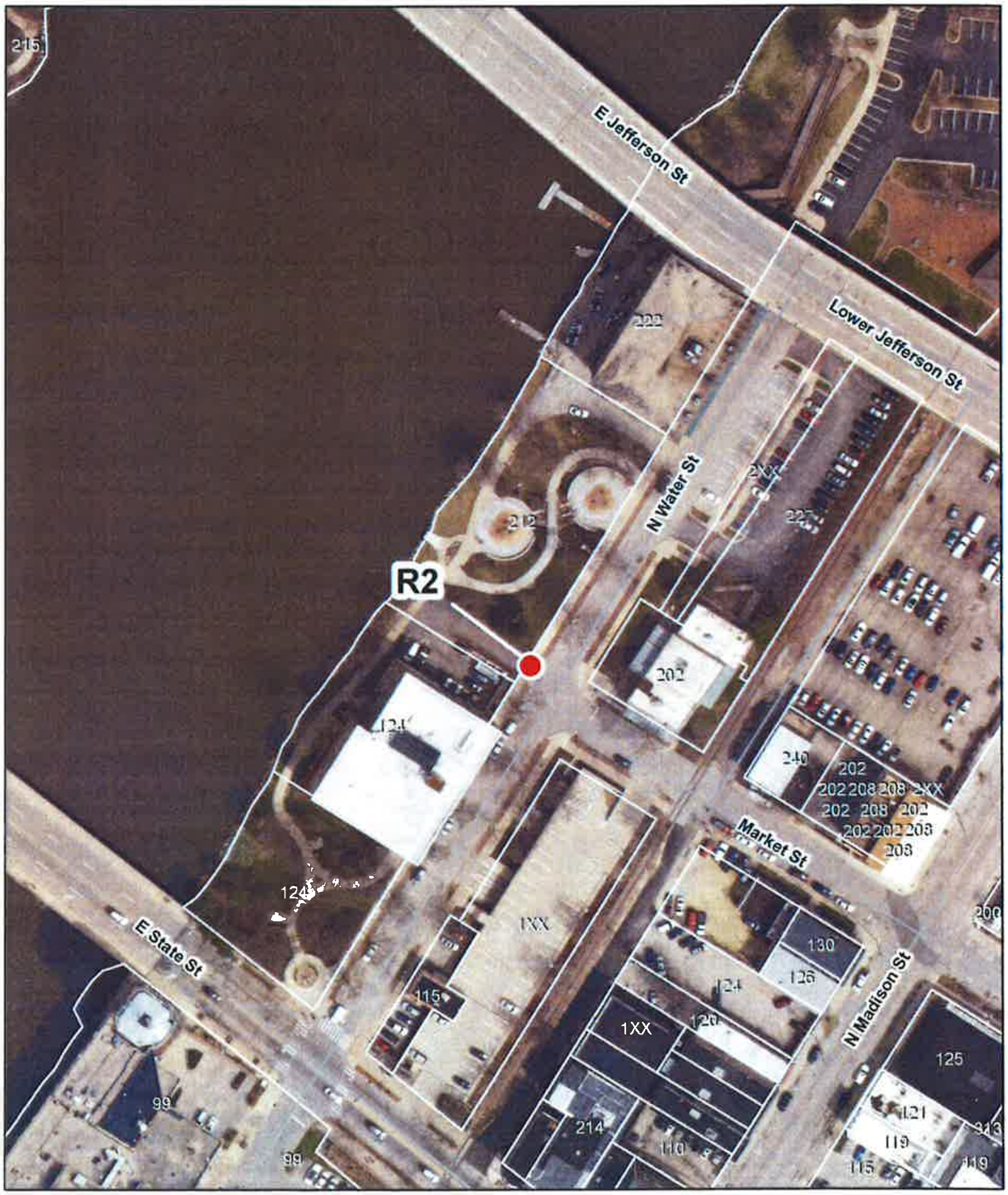
Appendix I

Outfall Site Map



Appendix J

Outfall Site Map



R2 - Market St & N Water St

1 inch = 100 feet

0 50 100 200 300 Feet

Appendix K

Outfall Site Map

Appendix L

Outfall Site Map

Appendix M

Outfall Site Map

R5 - Forest View Rd & 28th Ave

1 inch = 100 feet

0 50 100 200 300 Feet

N

Appendix N

Baetis

ROCK RIVER WATER RECLAMATION DISTRICT
Storm Water Sample Sheet

LAB NUMBER:

Outfall Number:	Fecal Grab Grid Locations:
Date:	Sample Tech(s):
Weather Conditions:	

STREAM CHARACTERISTICS

Sample Grid Location	Time Collected	D.O.	Temp °C	pH	River Elevation	Secchi Disc Clarity

COMPOSITE SAMPLE DATA

Sample Volume:

Preservative:

CHAIN OF CUSTODY

Relinquished by:	Rec'd by:
Date:	Date:
Time:	Time:

Sample Number:

Analysis Requested	Result (indicate units)	Analyst	Analysis Requested	Result (indicate units)	Analyst
METALS			pH		
Cu			Conductivity		
Cd					
Zn					
Pb			Fecal Coliform		
			BOD		
			COD		
			TSS		
			FOG		
NITROGEN					
TKN					
NH^3					
NO_3					
CYANIDE					
Total					
			Other		
PHOSPHORUS					
Total					
Chemist:				Date:	

ROCK RIVER WATER RECLAMATION DISTRICT
Tributary Sample Sheet

LAB NUMBER:

Site:	*Fecal Grab :*
Date:	*Sample Tech(s):*
DO Probe Model No.:	*DO Probe Serial No.:*
Weather Conditions:	

STREAM CHARACTERISTICS

Sample Grid Location	*Time Collected*	*D.O.*	*Temp °C*	*pH*	*Conductivity*	*Secchi Disc Clarity*

COMPOSITE SAMPLE DATA

Sample Volume:

Preservative:

CHAIN OF CUSTODY

Relinquished by:	*Rec'd by:*
Date:	*Date:*
Time:	*Time:*

ag/excel/2000/forms/RiverSampleSheet Rev. 11/28/2004

Sample Number:

Analysis Requested	Result (indicate units)	Analyst	Analysis Requested	Result (indicate units)	Analyst
METALS			pH		
Cu			Conductivity		
Cd					
Ni					
Cr			Fecal Coliform		
Zn			E. coli		
Pb			BOD		
			COD		
			TSS		
			TDS		
NITROGEN			Hardness		
NH^3					
NO_3					
CYANIDE					
Total					
			Other		
PHOSPHORUS					
Total					

Chemist: Date: